

MONTHLY STATUS REPORT

OCTOBER, 1998

Solar Terrestrial Relations Observatory (STEREO)

SYSTEM

The STEREO design effort started this month with about 15 team members. Weekly team meetings are underway with Goddard Space Flight Center (GSFC) participation encouraged. The meeting topics for the first month included the science goals, top-level requirements, mission design, and launch vehicle selection. Over the next two months a conceptual spacecraft design will come together as each subsystem lead presents his/her design to the group. Handouts from the meetings are available at <http://sd-www.jhuapl.edu/STEREO/Reports/>.

MISSION DESIGN AND NAVIGATION

Mission orbits for both spacecraft were analyzed for several years under a variety of conditions. Preliminary Sun-spacecraft-Earth geometries were presented to the study team. Very early work was started on possible navigation techniques, including autonomous on-board navigation.

LAUNCH VEHICLE AND PROPULSION

Three potential launch-vehicle options are under study. They are the TAURUS, the ATHENA II and the Shuttle. (The Delta II has been eliminated because of insufficient payload volume.) Face-to-face meetings were held with Orbital Sciences Corp. for the TAURUS and Lockheed Martin for the ATHENA II. The qualified TAURUS configuration has sufficient room but is a little shy in lift capability to the desired orbit. The ATHENA II in the Lunar Prospector configuration has sufficient lift capability but has limited payload volume due to the intrusion of the STAR 37. Shuttle details are awaiting a proposal from United Space Alliance (USA).

A regulated cold gas system has been baselined with 4 double-canted 1 N thrusters. Mass, tank volume and power have been determined for the required 5 years of momentum dumping torque. Spreadsheets have been developed for propellant requirement determination, tank sizing, thruster force, torque vs. thrust level, and location and cant angle.

SOFTWARE

Preliminary instrument interface definitions have been compiled and reviewed with GSFC as input to their STEREO instrument Announcement of Opportunity.

Software changes required from Thermospheric, Ionospheric, Mesospheric Energetics and Dynamics (TIMED) baseline have been identified for impact studies. They include: (1) addition of gimballed antenna; (2) differences in guidance and control sensors and actuators; (3) addition of high speed serial interface for the Solar Coronal Imaging Package (SCIP) instrument; (4) safing changes due to single string spacecraft; and (5) addition of requirement for "one-way" Doppler navigation data downlink.

MECHANICAL

The emphasis during the last month was to come up with a spacecraft configuration that was compatible with either the Taurus launch vehicle or the Athena launch vehicle. A spacecraft configuration is evolving which looks promising. The spacecraft is an irregular hexagon shape with an X-frame type structure. The X-frame has been found to provide a structurally stiff open framework structure, which is very weight efficient. Pro/ENGINEER models are being developed for each of the known payload components and candidate scientific instruments, so that a fully populated spacecraft configuration can be produced.

STRUCTURE

Preliminary information has been obtained concerning structural requirements and launch environments. As the spacecraft design begins to mature, work will start on a simple finite element model to be used for a jitter study.

COMMAND AND DATA HANDLING

Efforts over the last several weeks have involved compiling existing Near Earth Asteroid Rendezvous (NEAR) and TIMED Command and Data Handling (C&DH) hardware configuration information to determine their degree of applicability to the STEREO mission. C&DH technical issues unique to the STEREO spacecraft are being identified and incorporated into the design. A baseline C&DH system configuration has been identified and alternate configurations are being addressed with an emphasis on satisfying the mission requirements with the least expensive solution.

POWER

The Solar Stereo effort has begun this quarter with preliminary definition of loads and mission trajectory. An Excel-based solar array model was created which should expedite the analysis of the power system.

THERMAL

The STEREO thermal design effort is focusing on the identification of resource requirements and capabilities. The thermal design is undergoing constant revision as the latest inputs from the STEREO team are taken into account. A general philosophy for reliable thermal control is to bias the spacecraft slightly cold and then use operational heaters and thermostats to actively set the desired temperatures. Instrument temperature and power requirements are being reviewed to determine if the baselined thermal interface is appropriate. In general, instruments requiring extremely cold temperatures should be isolated from the spacecraft.

TELECOMMUNICATION

A preliminary trade-off was made between a gimbaled high-gain antenna and an electronically gimbaled phased-array antenna. It was determined that the phased array would result in a penalty in weight and power over the gimbaled dish, so the parabolic dish has been baselined.

Work has started on defining requirements for the C&DH receiver and transmitter cards, which are based on TIMED design concepts. The performance parameters of the Deep Space Network's (DSN) 34-m antennas for the link calculations have been detailed and verified. Work is continuing on defining the normal-mode data rates supported for various telecommunications configurations. The link performance is being calculated for variations in spacecraft transmit power, antenna size and margin versus distance/time from launch. Work is starting on defining the other modes of operations using the low-gain and medium-gain antennas based on the mission profile.

GUIDANCE AND CONTROL

Internal design brainstorming sessions were held for possible techniques for managing momentum by solar pressure control. Located and reviewed published information for SMEX-class spacecraft, notably TRACE & SWAS, for general background and to determine characteristics of their attitude control components.

The existing TIMED dynamics and attitude control simulation was adapted to a STEREO model, in Matlab/Simulink. Non-applicable TIMED models have been removed, and some preliminary STEREO runs made. In near future models for the instrument error signal, the propulsion system, and solar pressure disturbances will be added to the simulation. Polynomial-based and integrator-based methods for ephemeris propagation are under consideration, and the selected type will also be added.

GROUND SYSTEM, I&T & MISSION OPS

Meetings were conducted with TIMED's integration and test team and operations staff. As a result of these meetings we have obtained TIMED documents which will be needed for STEREO. We are still in the data-gathering mode, which will continue next month. Concepts are being developed for the simultaneous integration and operations of two spacecraft.

PRODUCT ASSURANCE

Radiation analysis, being supplied by GSFC, should be completed by mid-November. Until then we are using the ACE environment as a baseline. The STEREO Procurement Product Assurance Requirements (ProcPAR) document is being prepared.